

WHAT IS CLAIMED IS:

1. A trauma mitigation device comprising:
an enclosure having a fluid impervious barrier;
a crushable matrix disposed within said enclosure; and
a viscous fluid disposed within said enclosure.
2. The trauma mitigation device of Claim 1 wherein:
said viscous fluid includes macrosphere particles having a diameter between
about 0.5 mm and 5.0 mm.
3. The trauma mitigation device of Claim 2, wherein said fluid has a
viscosity between about 300,000 CPS to 6,000,000 CPS.
4. The trauma mitigation device of Claim 1, wherein said fluid has a
viscosity between about 300,000 CPS to 6,000,000 CPS.
5. The trauma mitigation device of Claim 1, wherein the crushable matrix
has a plurality of matrix elements selected from the group consisting of: cylinders,
hemispheres or pyramids.
6. The trauma mitigation device of Claim 5, wherein said crushable
matrix includes a supporting layer disposed adjacent to said enclosure.
7. The trauma mitigation device of Claim 6, wherein said supporting
layer is metal fashioned in a crushable shape.
8. The trauma mitigation device of claim 7, wherein said crushable shape
is a corrugated sheet.
9. The trauma mitigation device of Claim 7, wherein said crushable shape
is a plurality of hexagonal cells.
10. The trauma mitigation device of Claim 6, wherein said supporting
layer is made from a material selected from the group consisting of: ductile metal,
polymeric material, ceramic, or ceramic alloy.
11. The trauma mitigation device of Claim 5, wherein said enclosure is
formed from a flexible material selected from the group consisting of: a polymeric
film, fully-reticulated foam, rubberized woven fabric, rubberized non-woven fabric,
elastomeric woven material, or elastomeric non-woven material.
12. The trauma mitigation device of Claim 11, wherein said flexible
material is formed having at least one accordion pleat along an edge of said enclosure.

13. The trauma mitigation device of Claim 11, wherein said material is formed of a pair of parallel barriers each about 20 mils thick.

14. The trauma mitigation device of Claim 5, wherein said enclosure includes a layer of foam connected to a pressurized air source.

15. The trauma mitigation device of Claim 1, wherein:
the crushable matrix includes a plurality of hemispheres; and
said hemispheres disposed in pairs connected at the convexities

16. The trauma mitigation device of Claim 15, wherein said viscous fluid is disposed inside of and outside of said hemispheres.

17. The trauma mitigation device of Claim 1, wherein:
the crushable matrix includes a plurality of pyramids; and
said pyramids disposed in pairs connected at the apexes.

18. The trauma mitigation device of Claim 17, wherein said viscous fluid is disposed outside of each said pyramid.

19. The trauma mitigation device of Claim 18, wherein:
wherein said crushable matrix includes a supporting layer;
said each pyramid in said plurality of pyramids has a base; and
each said pyramid base abuts said supporting layer.

20. The trauma mitigation device of Claim 17, wherein:
wherein said crushable matrix includes a supporting layer;
said each pyramid in said plurality of pyramids has a base with arms extending from said base; and
said arms contact said supporting layer.

21. The trauma mitigation device of Claim 1, wherein said enclosure is formed from a flexible material selected from the group consisting of: a polymeric film, fully-reticulated foam, rubberized woven fabric, rubberized non-woven fabric, elastomeric woven material, or elastomeric non-woven material.

22. The trauma mitigation device of Claim 21, wherein said flexible material is formed ~~having~~ at least one accordion pleat along an edge of said enclosure.

23. The trauma mitigation device of Claim 21, wherein said material is formed of a pair of parallel barriers each about 20 mils thick.

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24. The trauma mitigation device of Claim 1, wherein said enclosure includes a layer of foam connected to a pressurized air source.

25. A vehicle footwell comprising:

an upper cushion layer;

a trauma mitigation assembly disposed adjacent to said cushion layer;

said trauma mitigation assembly comprising:

an enclosure having a fluid impervious barrier;

a crushable matrix disposed within said enclosure; and

a viscous fluid disposed within said enclosure.

26. The vehicle footwell of Claim 24 wherein:

said viscous fluid includes macrosphere particles having a diameter between about 0.5 mm and 5.0 mm.

27. The vehicle footwell of Claim 26, wherein said fluid has a viscosity between about 300,000 CPS to 6,000,000 CPS.

28. The vehicle footwell of Claim 25, wherein said fluid has a viscosity between about 300,000 CPS to 6,000,000 CPS.

29. The vehicle footwell of Claim 25, wherein the crushable matrix has a plurality of matrix elements selected from the group consisting of: cylinders, hemispheres or pyramids.

30. The vehicle footwell of Claim 29, wherein said crushable matrix includes a supporting layer disposed adjacent to said enclosure.

31. The vehicle footwell of Claim 25, wherein said enclosure is formed from a flexible material selected from the group consisting of: a polymeric film, fully-reticulated foam, rubberized woven fabric, rubberized non-woven fabric, elastomeric woven material, or elastomeric non-woven material.

32. The vehicle footwell of Claim 25, wherein said enclosure includes a layer of foam connected to a pressurized air source.

33. A knee bolster comprising:

an upper cushion layer;

a trauma mitigation assembly disposed adjacent to said cushion layer;

said trauma mitigation assembly comprising:

an enclosure having a fluid impervious barrier;

a crushable matrix disposed within said enclosure; and

a viscous fluid disposed within said enclosure.

34. The knee bolster of Claim 33 wherein:

said viscous fluid includes macrosphere particles having a diameter between about 0.5 mm and 5.0 mm.

35. The knee bolster of Claim 34, wherein said fluid has a viscosity between about 300,000 CPS to 6,000,000 CPS.

36. The knee bolster of Claim 33, wherein said fluid has a viscosity between about 300,000 CPS to 6,000,000 CPS.

37. The knee bolster of Claim 33, wherein the crushable matrix has a plurality of matrix elements selected from the group consisting of: cylinders, hemispheres or pyramids.

38. A trauma mitigation composition comprising:

a viscous fluid in an amount of about 60-80% by weight of the total trauma mitigation composition; and

a plurality of macrosphere particles, in an amount of about 20-40% by weight of the total trauma mitigation composition, disposed within said viscous fluid.

39. The composition of Claim 38, further comprising a plurality of microsphere particles disposed within said viscous fluid, so that the total amount of macrosphere and microsphere particles combined is about 20-40% by weight of the total trauma mitigation composition.

40. The composition of Claim 38, wherein said macrosphere particles are comprised of foamed polymer.

41. The composition of Claim 40, wherein said foamed polymer is polystyrene.

42. The composition of Claim 38, wherein said macrosphere particles have a diameter of about .5 mm to 5 mm.

43. The composition of Claim 39, wherein said microsphere particles have a diameter between about 100 to 400 microns.

44. The composition of Claim 43, wherein said microsphere particles are selected from the group consisting of ceramic microspheres, plastic microspheres and combinations thereof.

45. The composition of Claim 38, wherein said viscous fluid has a viscosity of between about 300,000 CPS and about 6 million CPS.

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